



Nearshore Wave Prediction System (NWPS): On-demand Coastal Wave Model Guidance

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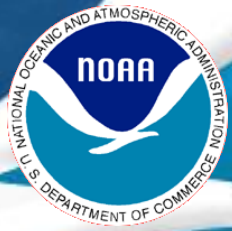
Jeffrey Hansson (USACE/CHL), Eve-Marie Devaliere (NESDIS/STAR),
Joe Long and Hilary Stockdon (USGS)

NCEP Science Quarterly, April 20, 2015



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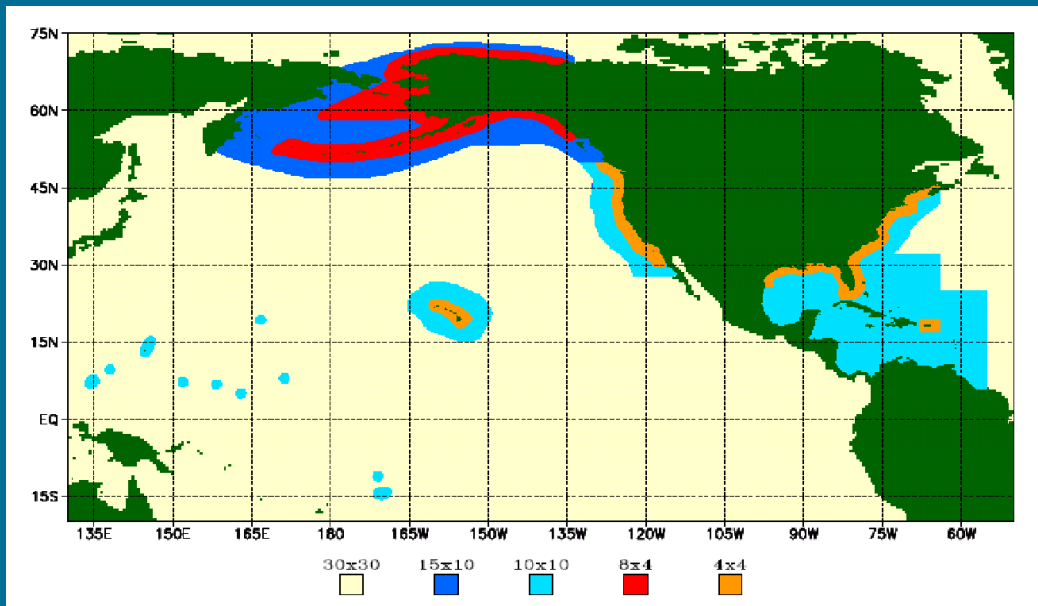
Outline

1. Need for nearshore wave guidance
2. NWPS system design
3. Input, output and data flow
4. System loading and Validation
5. Implementation schedule
6. Future apps: Rip currents and wave run-up



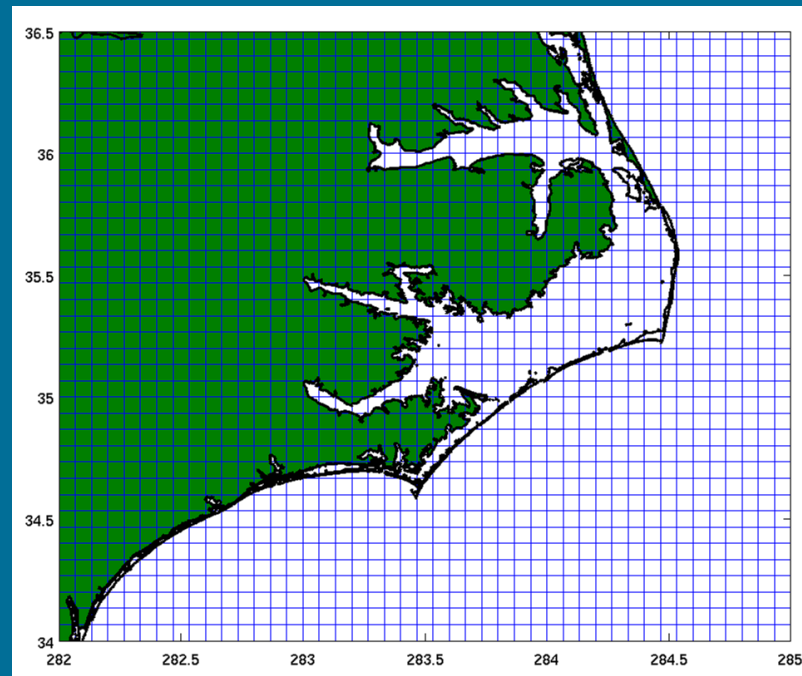
NCEP Wave guidance products

WAVEWATCH 3 global grid mosaic

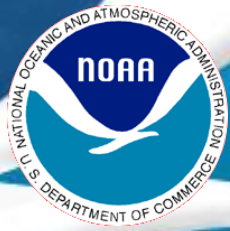


- Max. coastal resolution = 4 arc-min (7.5 km)
- Forced by GFS

Nearshore downscaling



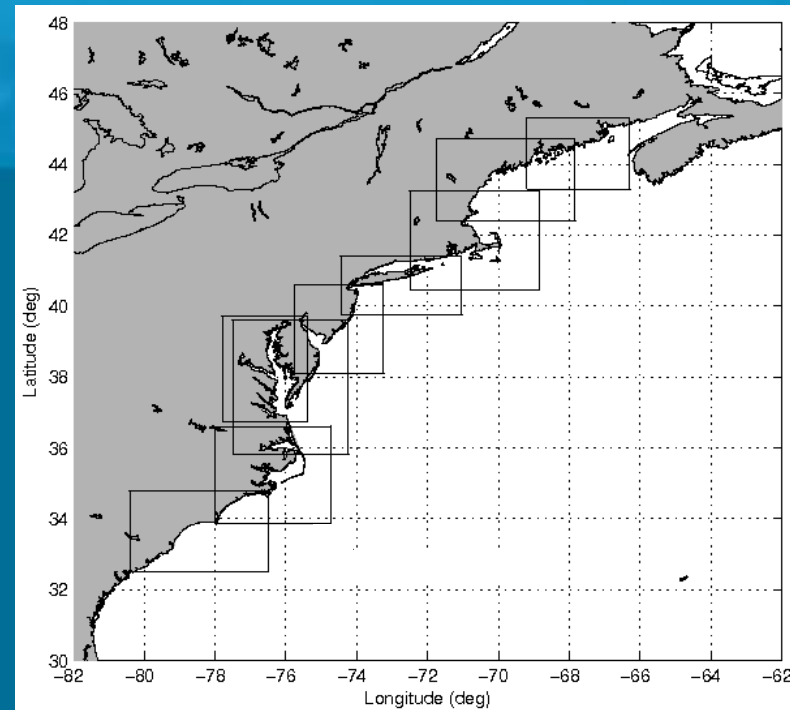
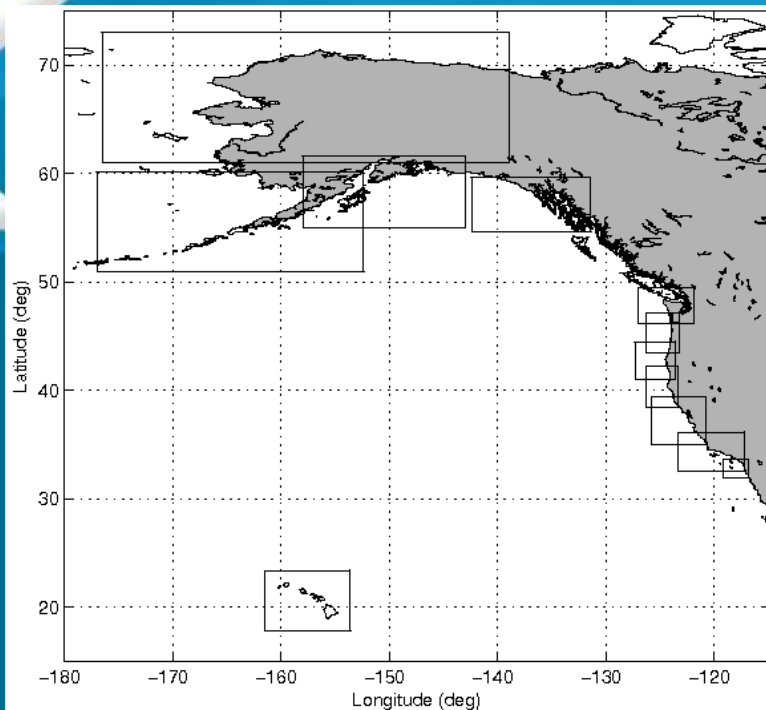
- Req. resolution = 500 m - 1.85 km
- Forecaster wind fields (GFE)



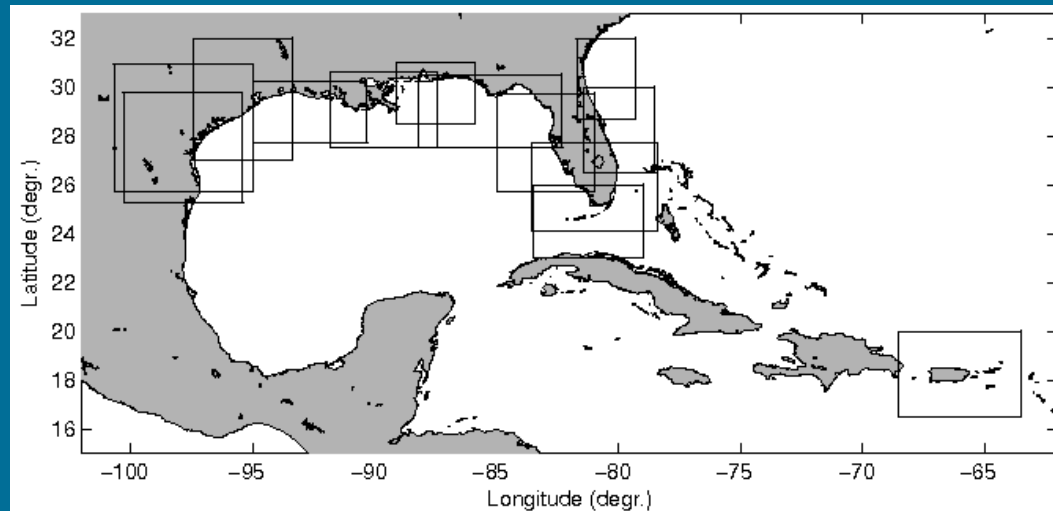
The Nearshore Wave Prediction System (NWPS)

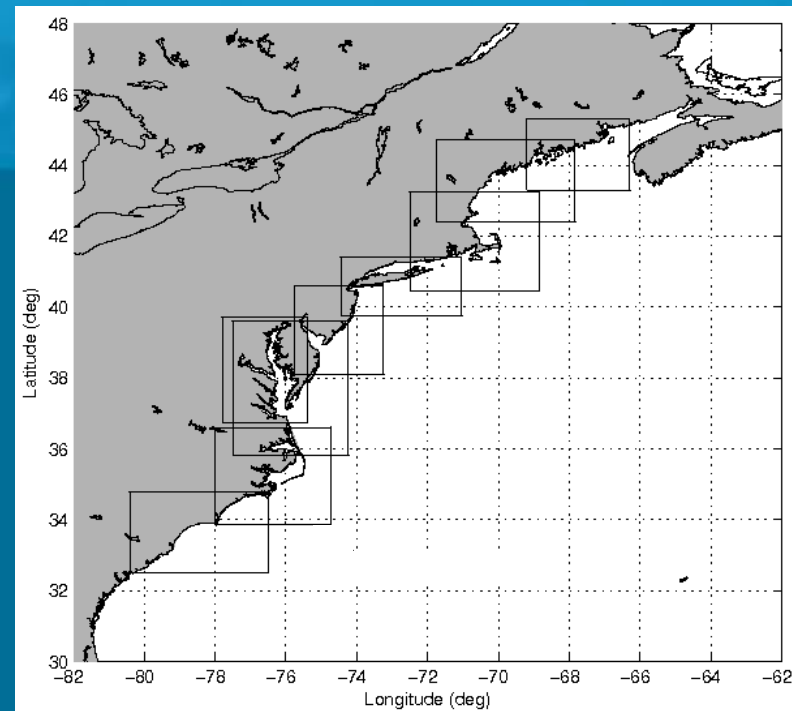
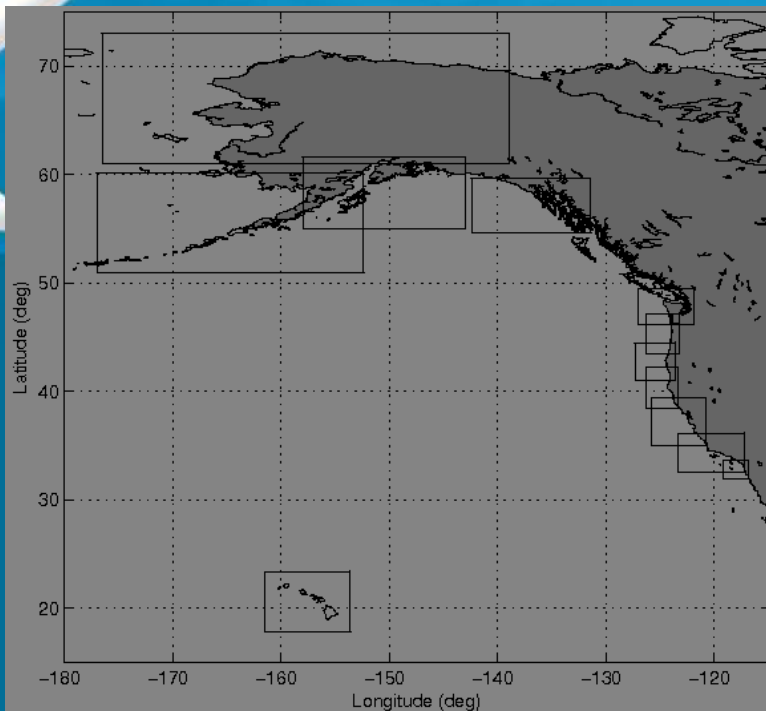
- Run on-demand, using open-source wave model SWAN.
 - Driven by forecaster-developed winds from GFE (AWIPS2), and other NCEP forcings (e.g. WW3 BCs, RTOFS/ESTOFS).
 - Included in the AWIPS2 baseline for sustainability.
 - Addresses region-specific physical processes in the nearshore (wave-current interaction, ice interaction, vegetation, etc.).
 - Includes wave partitioning (separates wave field into component systems). In future: rip current and wave run-up guidance.
- * WFO-based pilot project (WFO Eureka) transitioned to NCEP
- * Sandy Supplemental Milestone FY15Q4



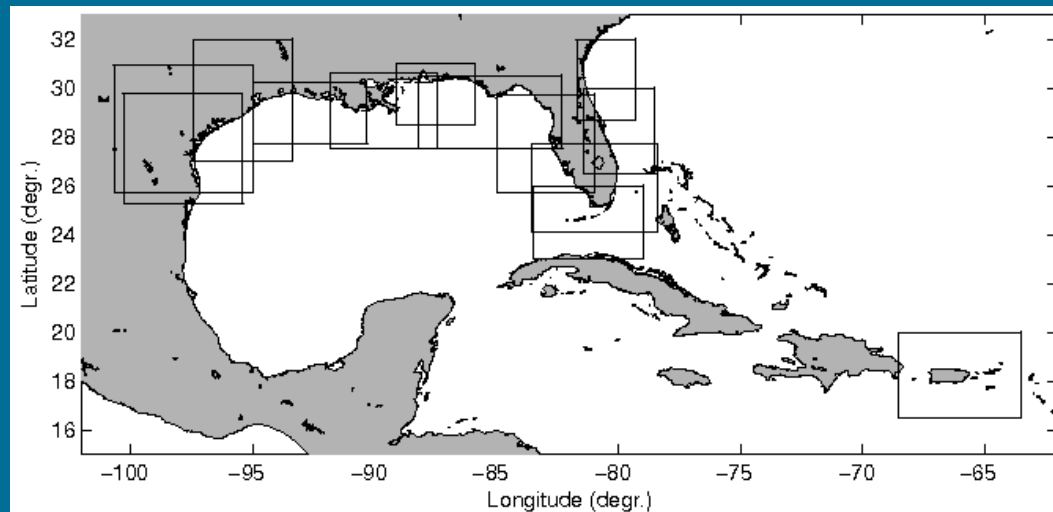


NWPS grids for coastal WFOs



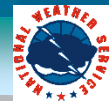
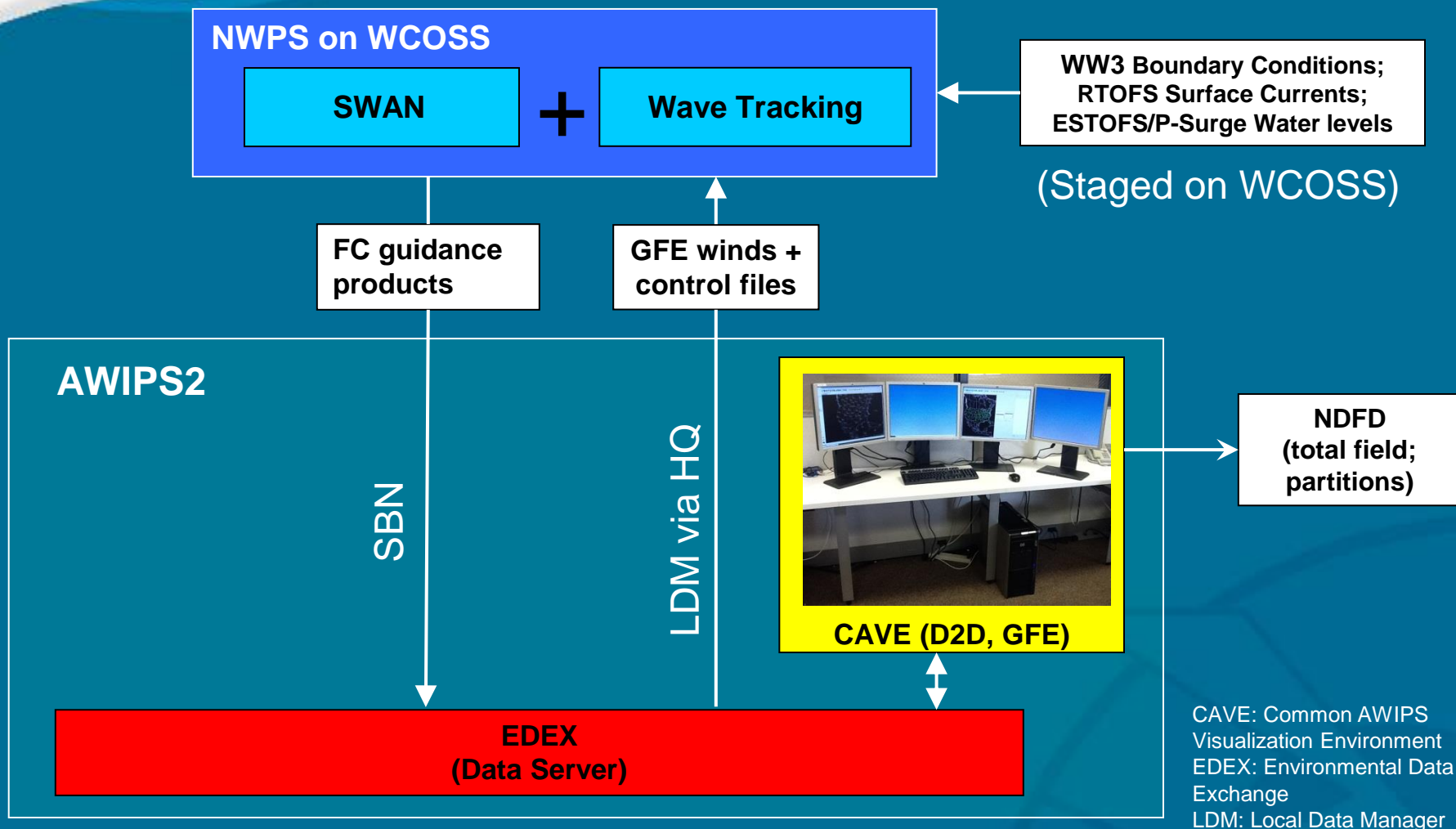


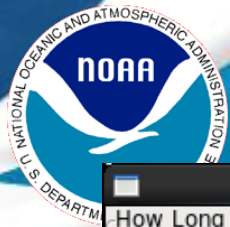
NWPS grids
for coastal
WFOs





NWPS Architecture (WFO view)





NWPS User Interface (AWIPS2 v14.4.1)

Run_NWPS Values

How Long Do You Want To Run NWPS: 102

Model Start Time: 20150211_1200 20150211_1800 20150212_0000 20150212_0600 **20150212_1200** 20150212_1800 20150213_0000

Local or NCEP: **Local** NCEP

Model Core: **SWAN** NWW UNSWAN

Send Output to Web: **Yes** No

Plot Output Only (No Web): **No** Yes

Boundary Conditions: **WNAWave** TAFB-NWPS HURWave No

****Boundary Conditions: OPC/TAFB-NWPS: CHECK www.srh.noaa.gov/rtimages/nhc/wfo_boundary_conditions for up to date files for your SITE****

NOTE: make sure there is a file time stamp online matching your selected Model Start Time

Run Hi Res NEST: **Yes** No

RTOFS Currents: **Yes** No

Model Time Step: 1200 900 **600** 300

Hotstart: **True** False

Waterlevels: **ESTOFS** PSURGE No

If PSURGE % Exceedance Hgt: **10** 20 30 40 50

OK Cancel

GRID file (GFE winds, text file)

DOMAIN file (9.6 kB text file)

CONTROL file (1 kB text file)

Size = ~2 Mb zipped

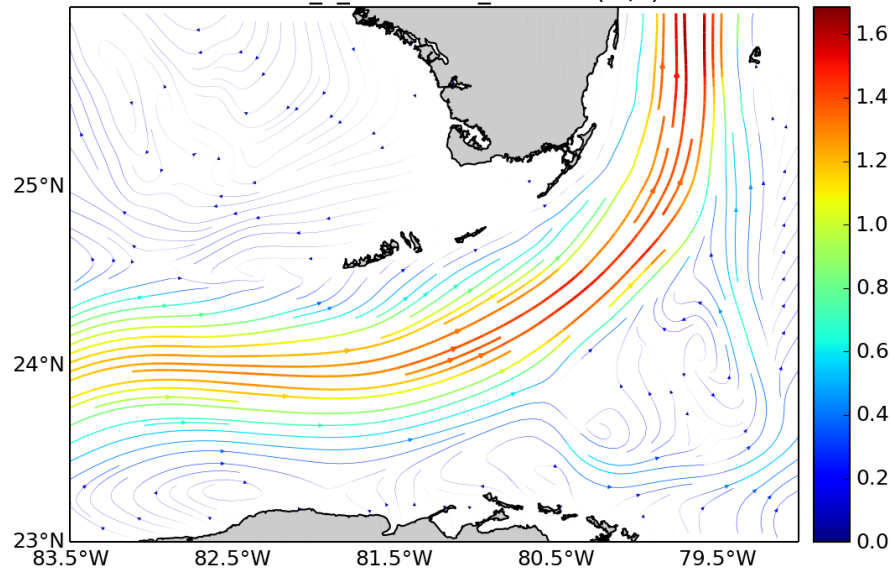




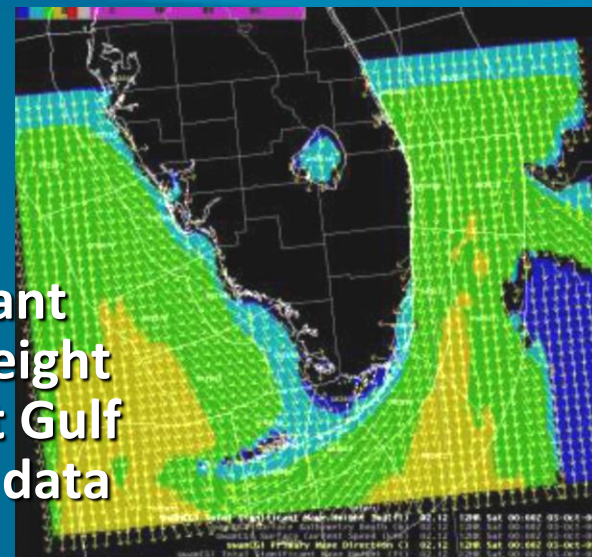
Forcings: Surface currents

RTOFS Global output of Gulf Stream

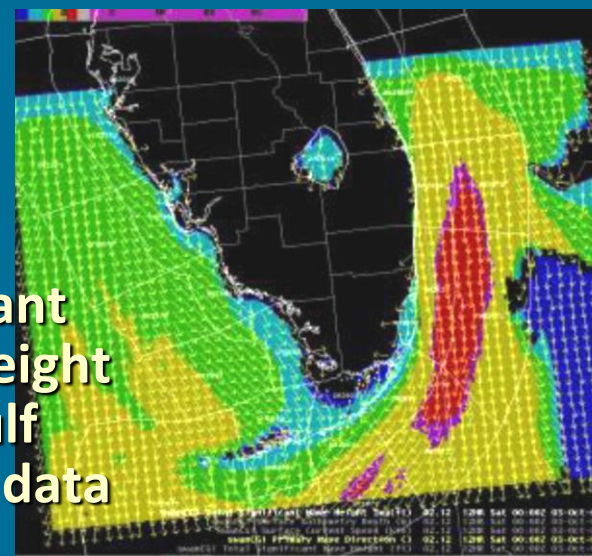
KEY: Vel_x 20140819_120000 (m/s)



Significant wave height without Gulf Stream data



Significant wave height with Gulf Stream data



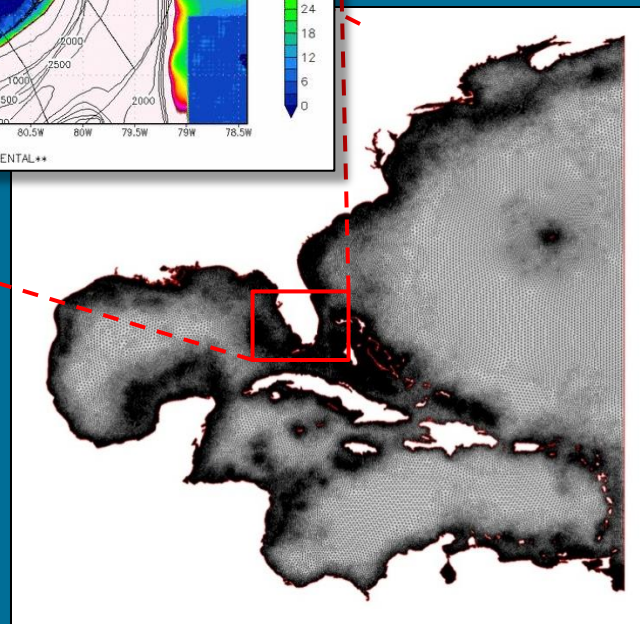
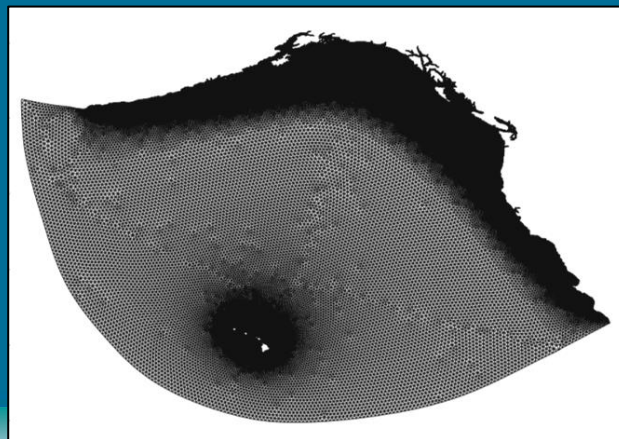
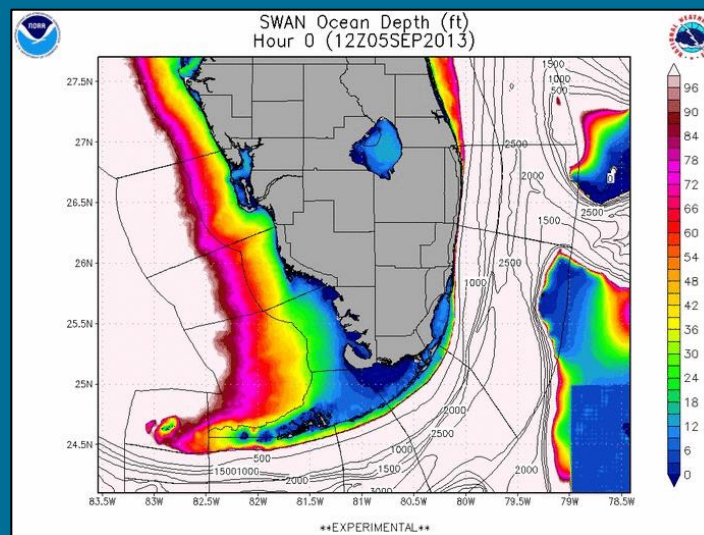
(Settelmaier et al. 2010)



Forcings: Water levels, Extra-tropical Surge & tides from ESTOFS Atlantic and Pacific

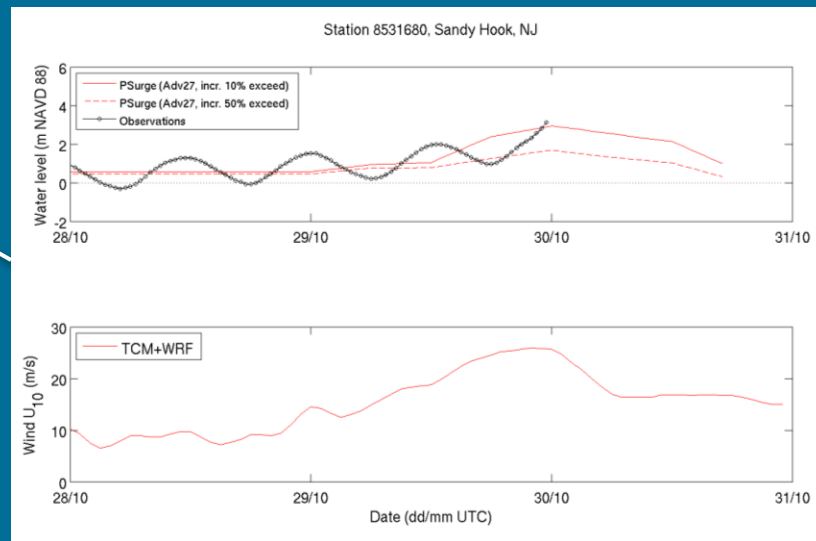
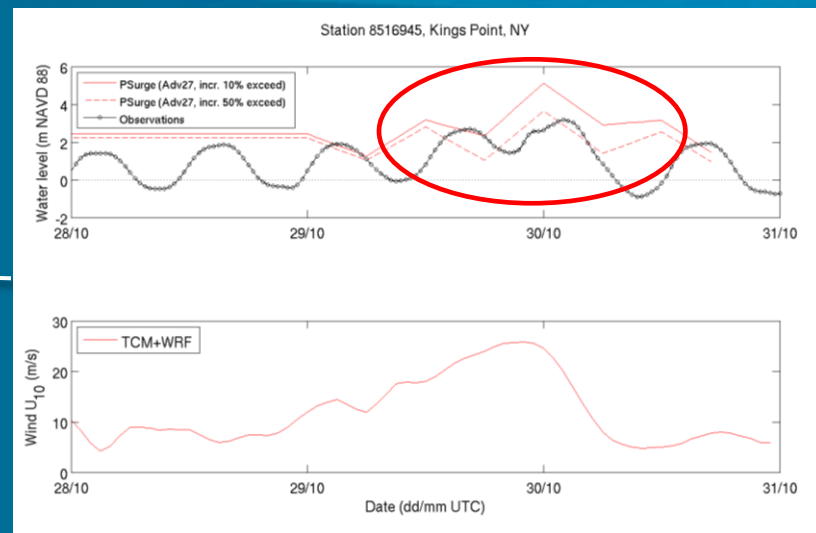
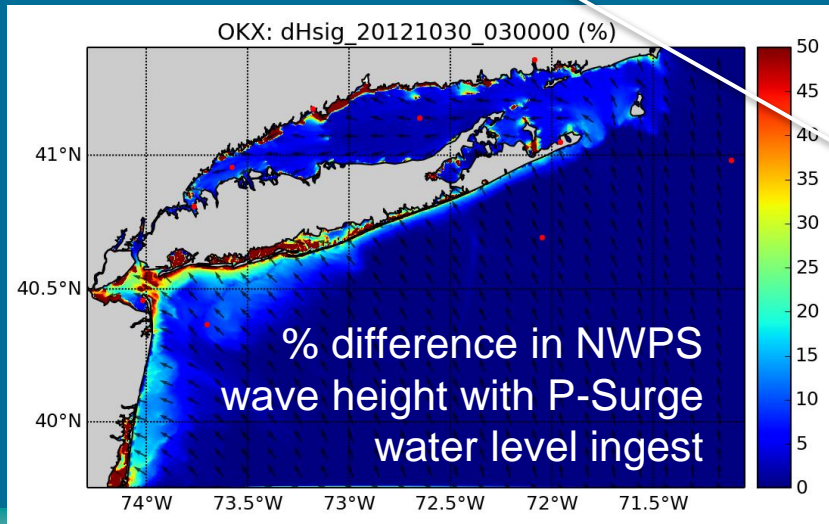
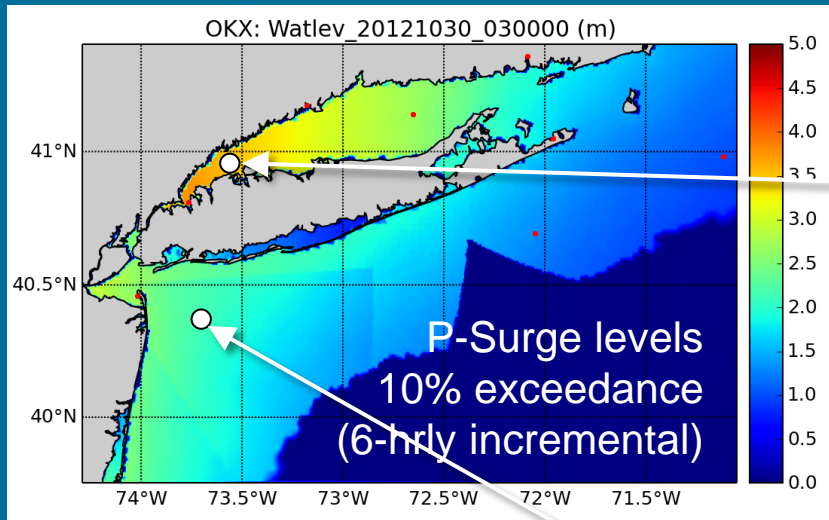
ESTOFS features:

- Single deterministic run, 4 cycles/day
- Coastal resolution $\approx 1\text{-}5\text{ km}$
- Barotropic ADCIRC model
 - Tidal boundary forcing at 60° W
 - Tidal forcing from TPXO 6.2 global tide model
 - Meteorological forcing from GFS (wind shear, inverse barometric effect)





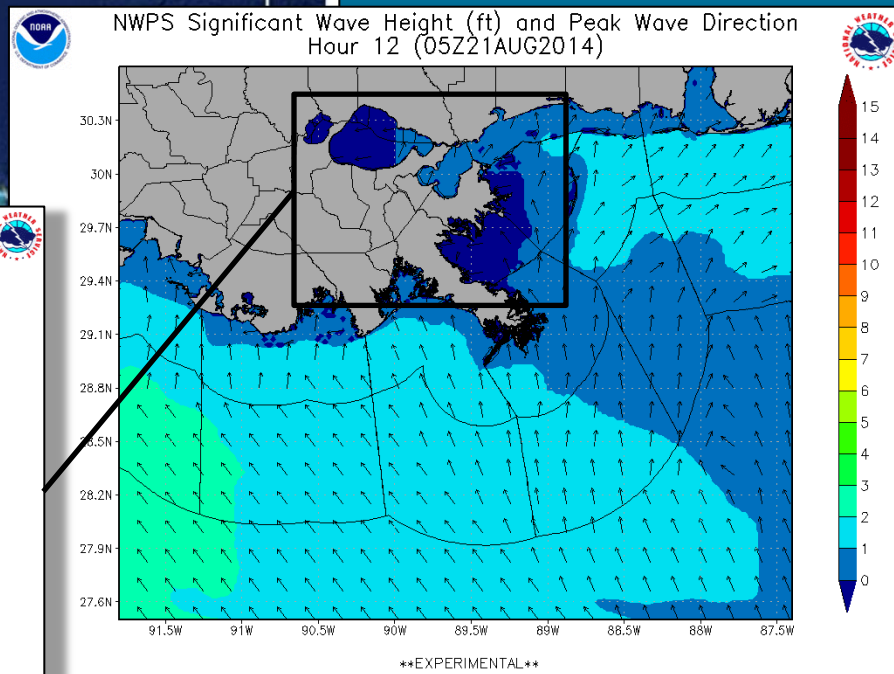
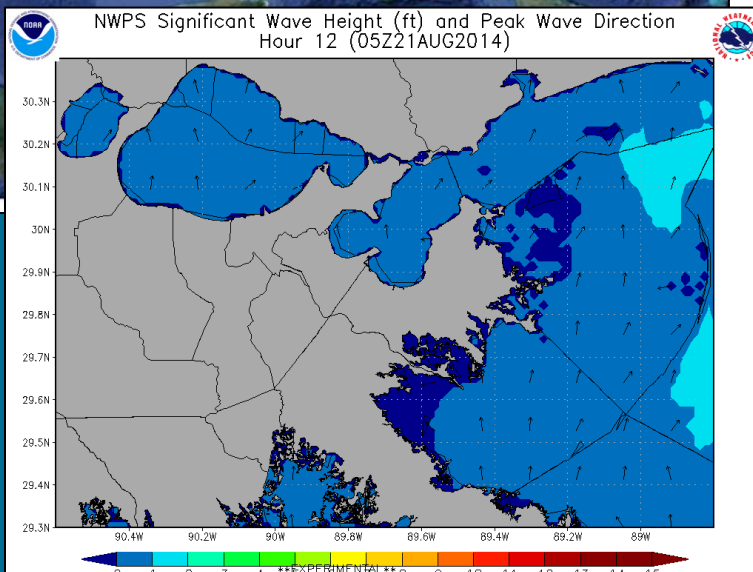
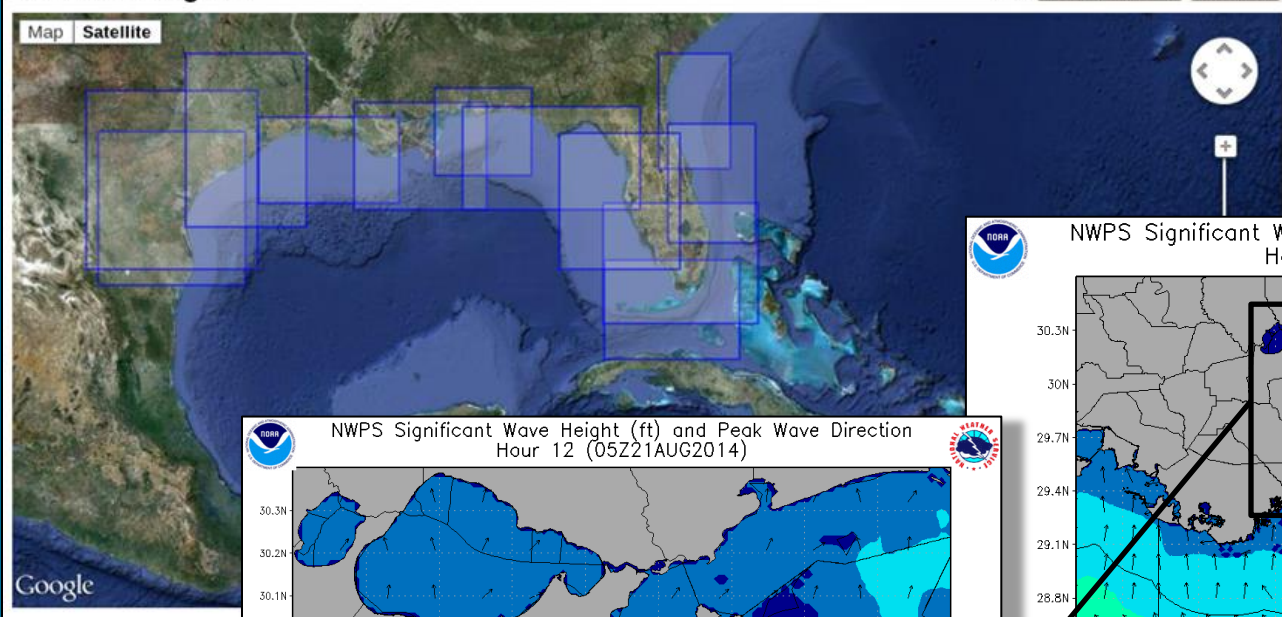
Forcings: Water levels, Tropical Surge level and tide from 1-hrly P-Surge 2.5





Example output for WFO New Orleans

Southern Region



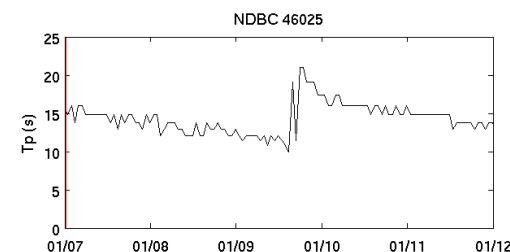
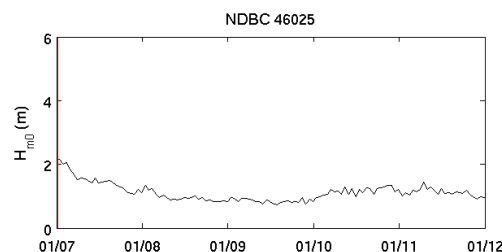
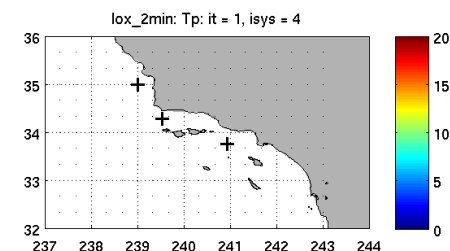
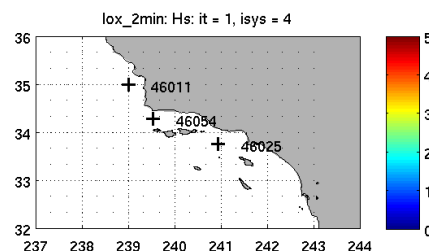
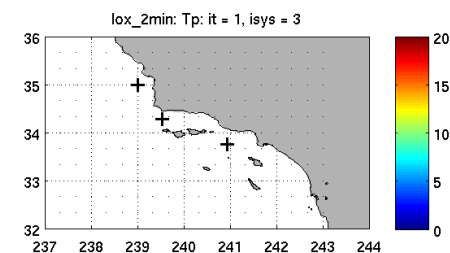
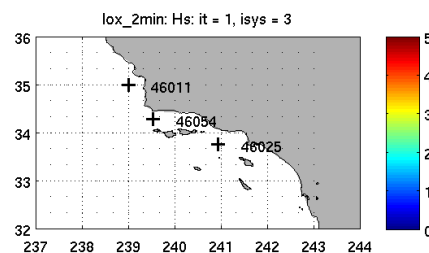
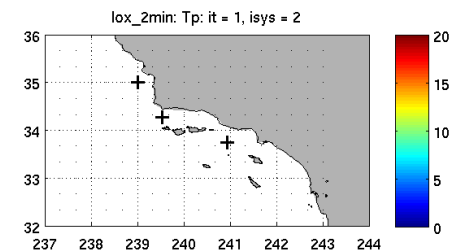
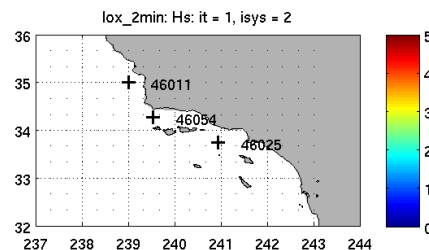
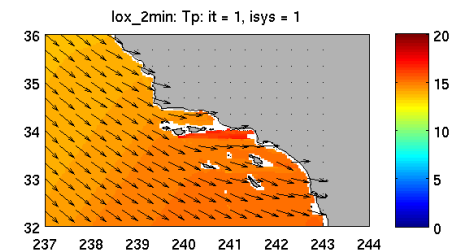
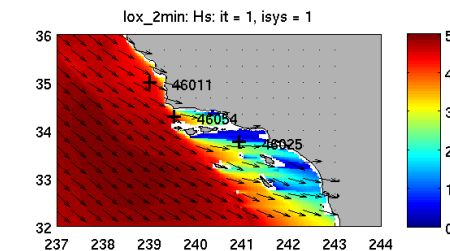
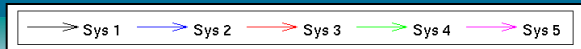
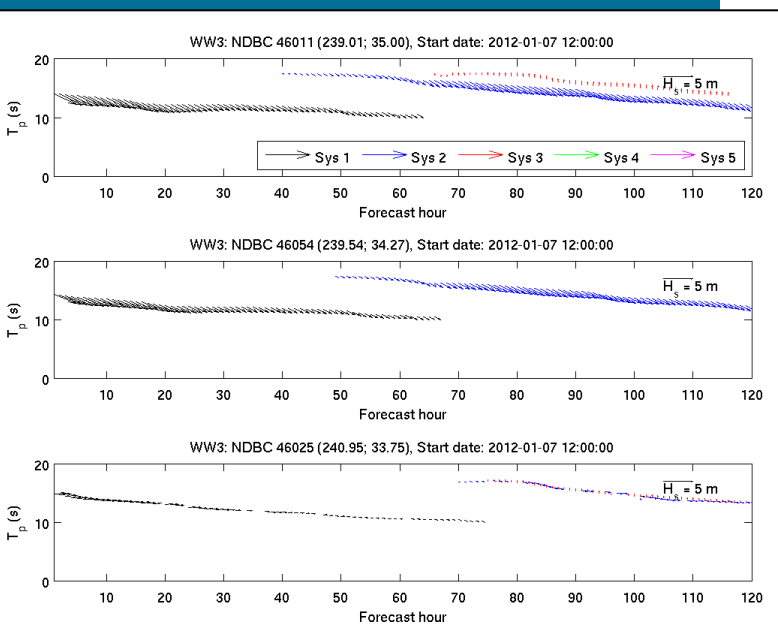
WFO LIX, CG1

CG2



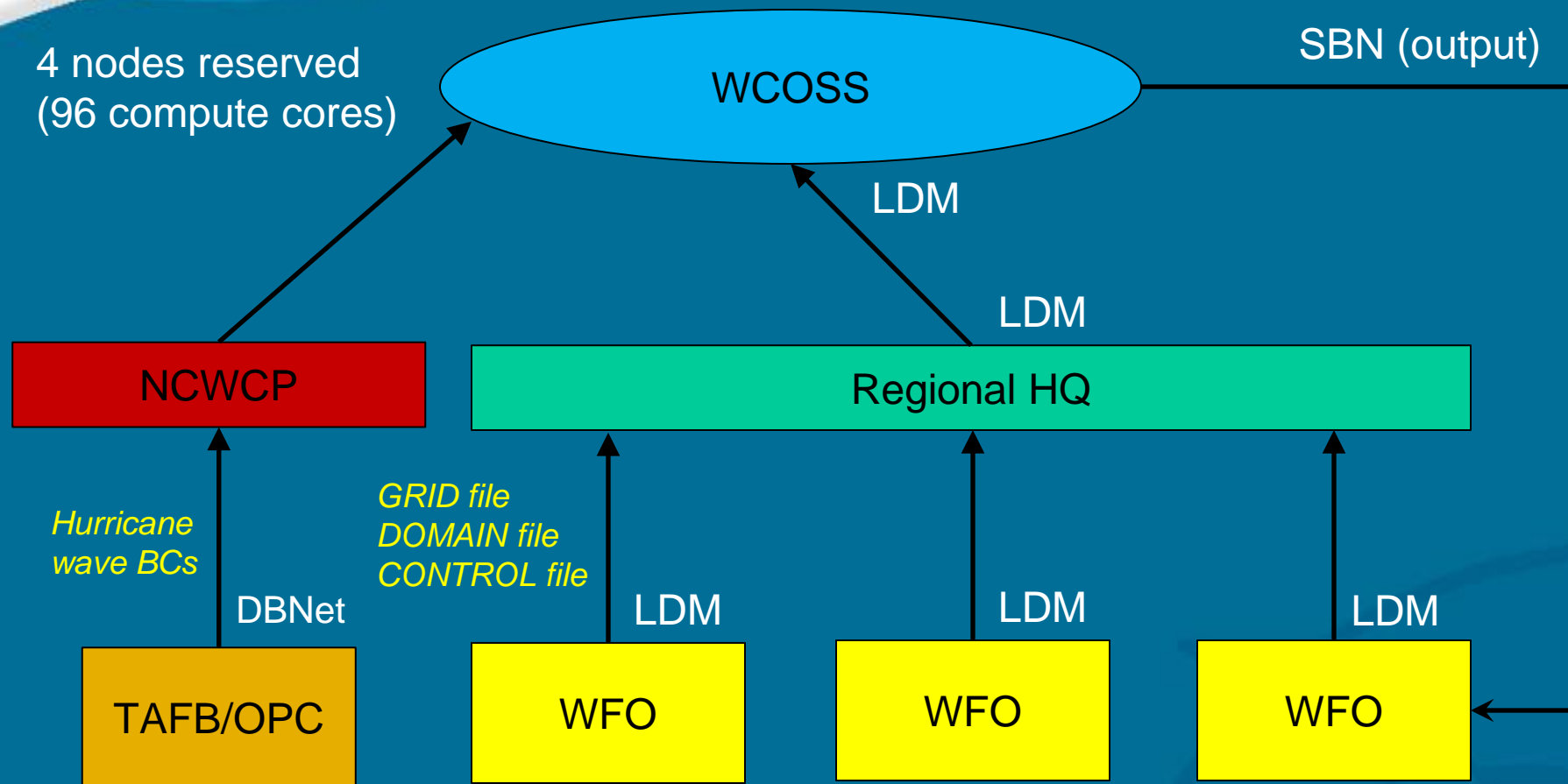


Post-processing: Wave system tracking



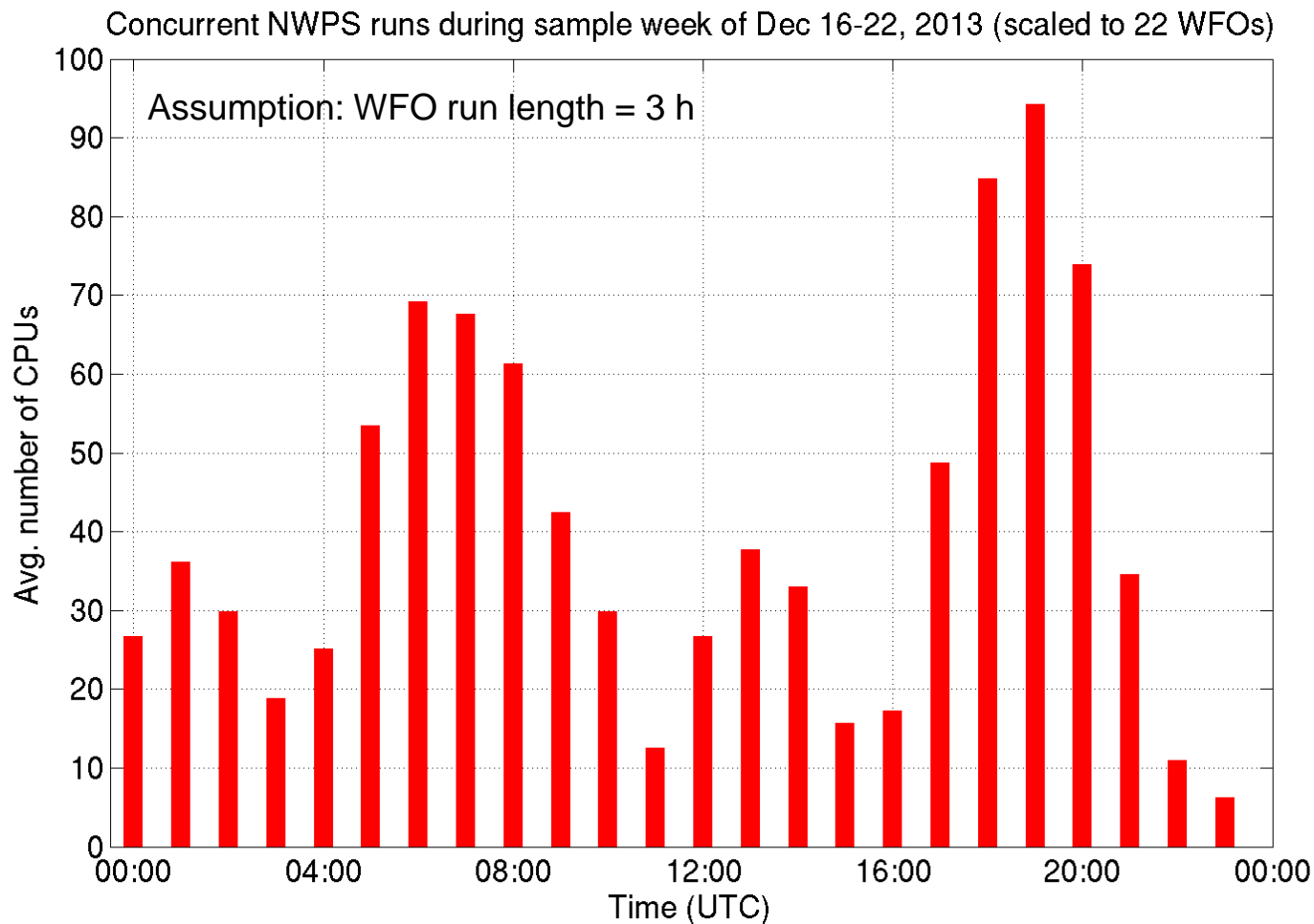


NWPS Architecture (Regional view)





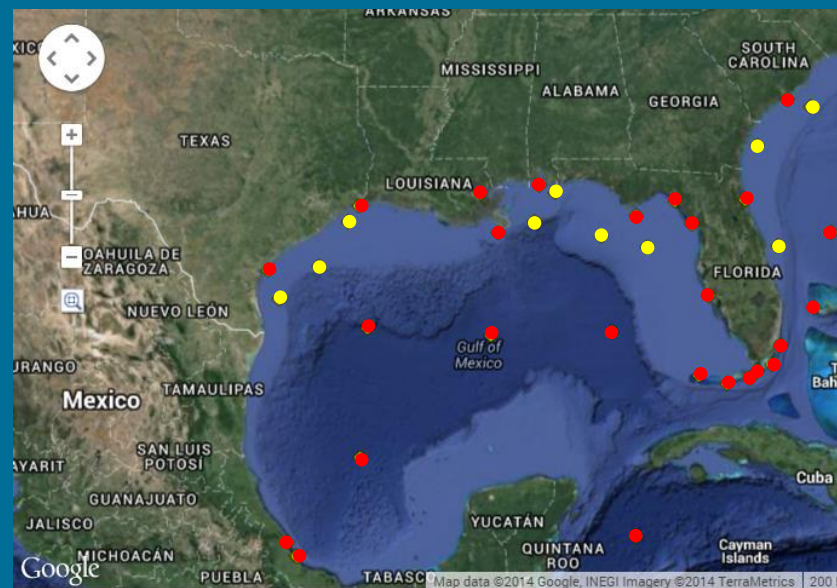
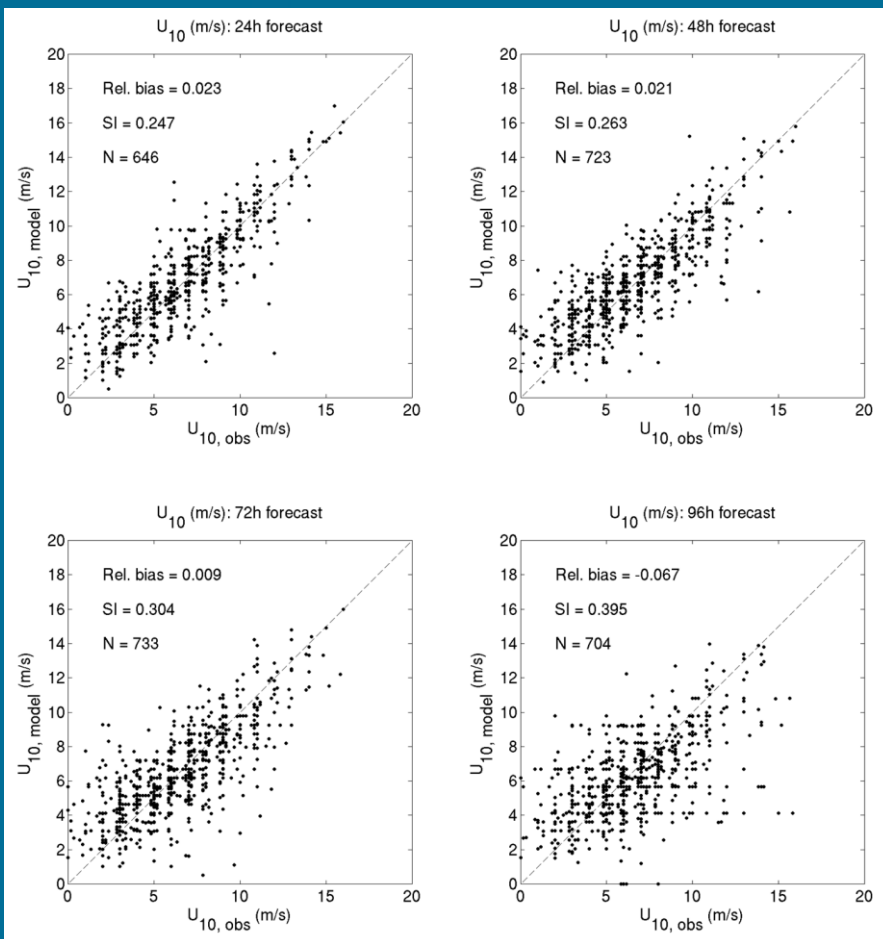
System load analysis





Nearshore model validation

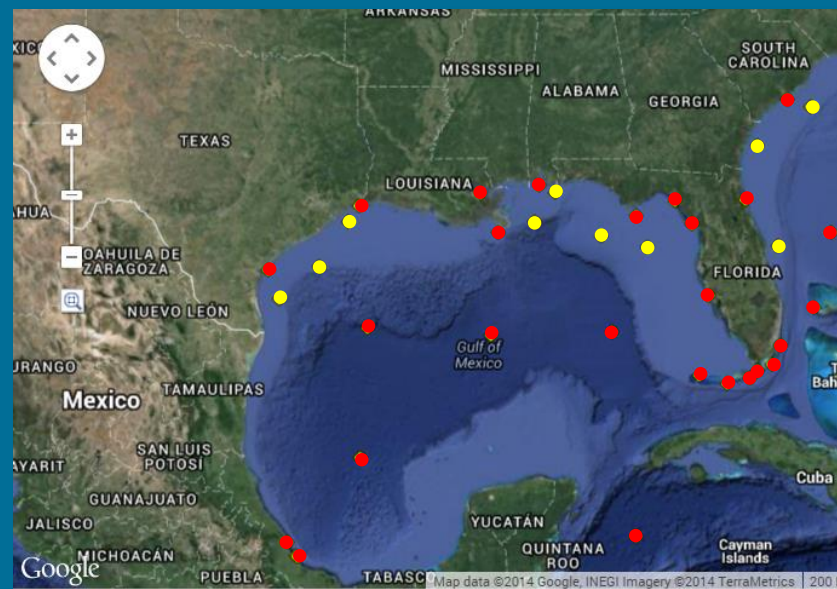
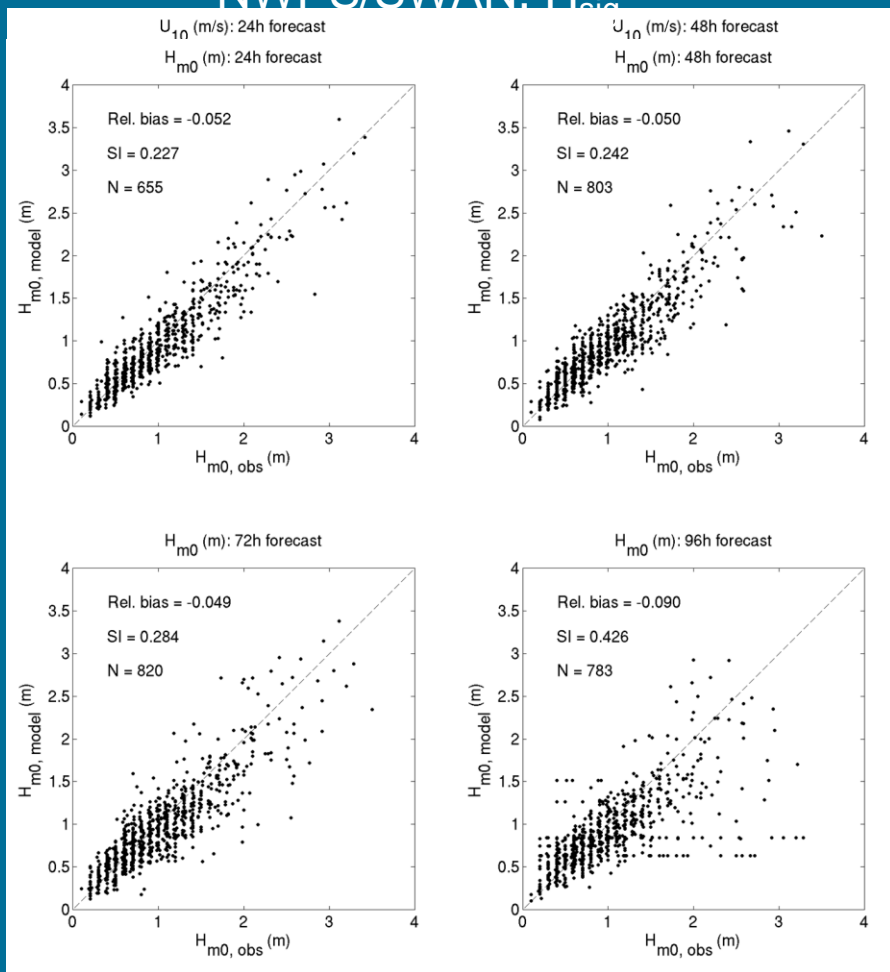
GFE winds: U_{10}





Nearshore model validation

GFF winds: U_{10}
NWPS/SWAN: H_{m0}

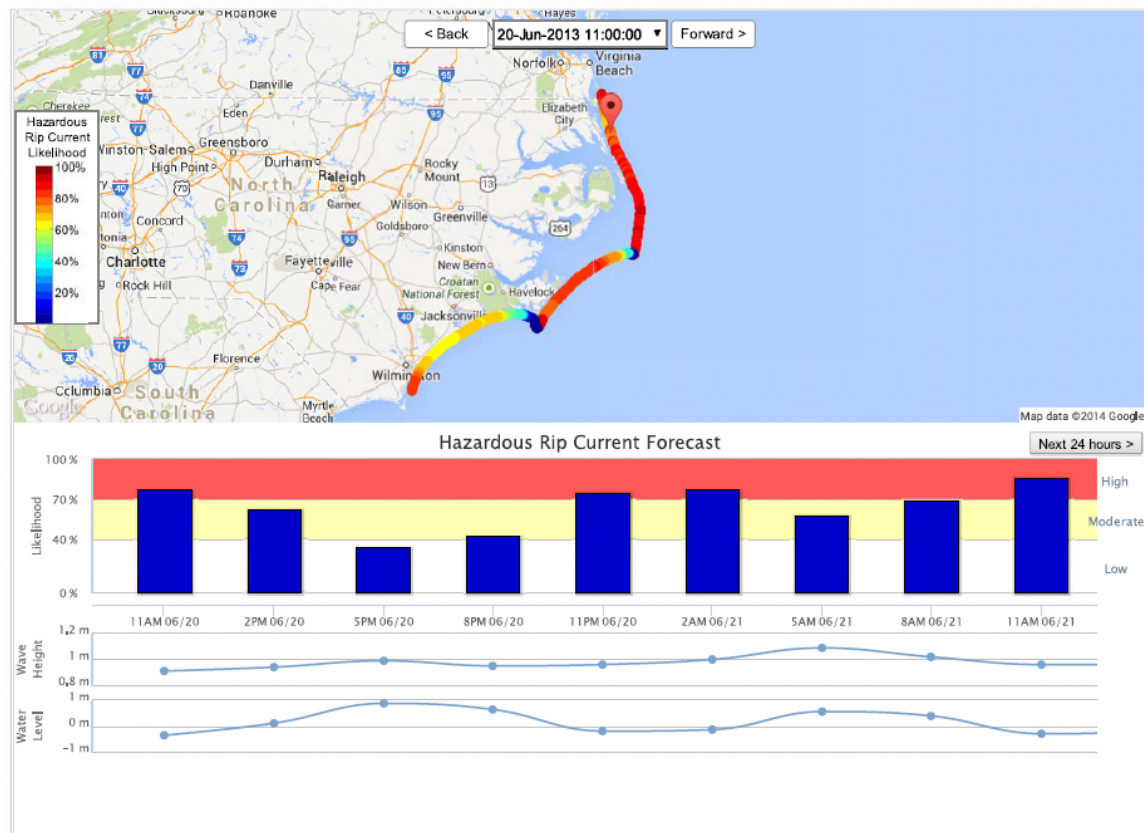




Applications (1): Rip current guidance

WFO Morehead City

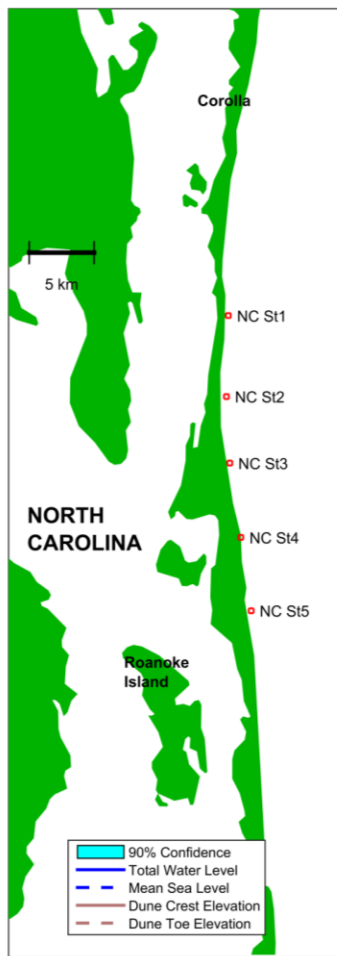
Rip Current Forecast Visualization Demo



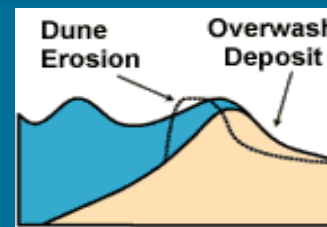
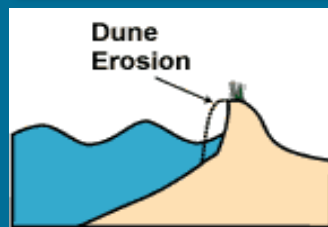
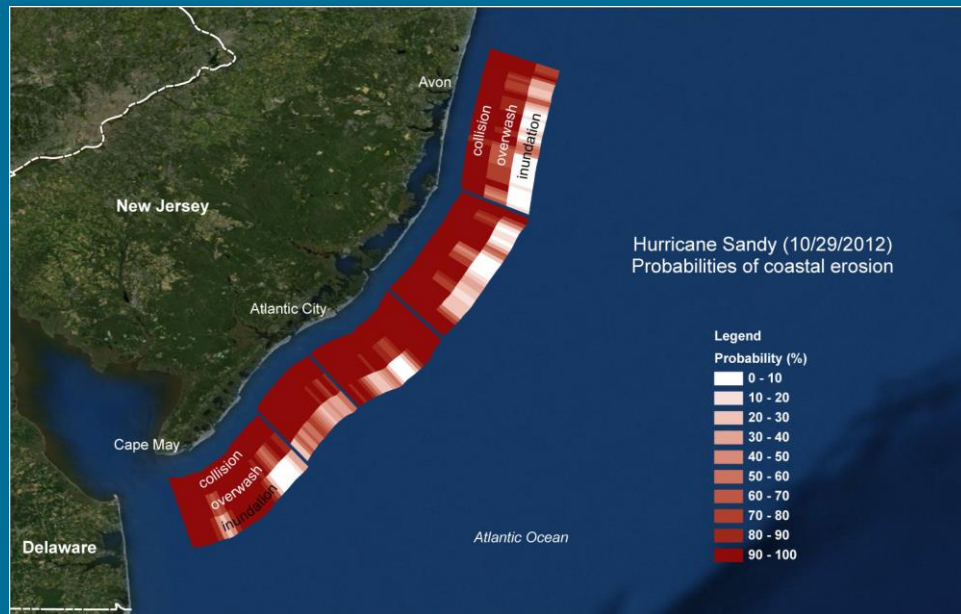
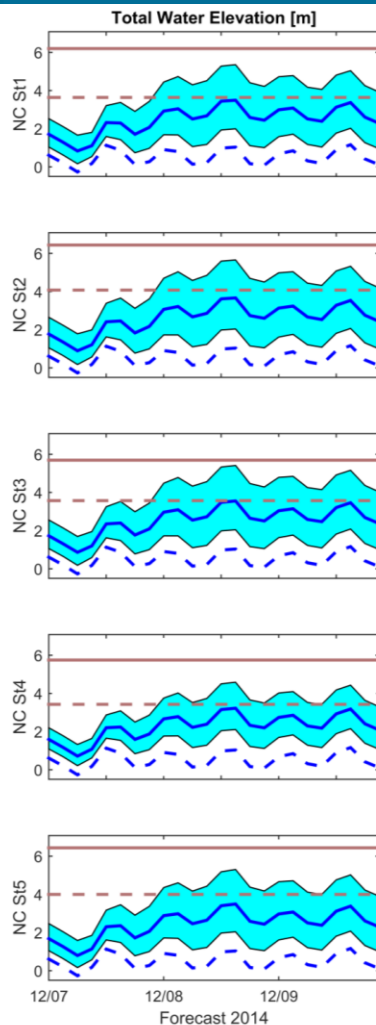
<https://sites.google.com/site/ripcurrentforecast/>



Applications (2): Wave runup guidance

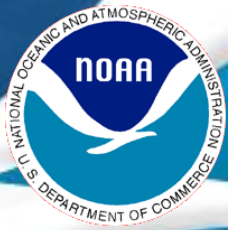


*Dune crest and toe derived from lidar collected November 2012 by Photoscience



WFO
Morehead City





Conclusions

1. NWPS: on-demand, high-resolution wave model guidance for coastal WFOs, standardized on the AWIPS 2 baseline.
2. Ensures consistent marine wind and wave guidance.
3. Water level and current ingest (RTOFS, ESTOFS and P-Surge).
4. Wave partitioning as input to gridded wave forecasts.
5. Southern and Eastern Region implementation: FY15Q4 (Sandy Milestone)





Nearshore Wave Prediction System (NWPS) V1.0.0

Project Status as of 03/06/2015



Project Information and Highlights

Lead: Hendrik Tolman, EMC and Chris Magee, NCO

Scope:

1. Centralized implementation of NWPS that is currently run locally at a number of coastal WFOs.
2. Involves separate implementations for approx. 20 WFOs, using shared basic scripting.
3. Novel on-demand run triggering.

Expected Benefits:

1. Resolution of coastal wave model guidance improved from 4 arc-min (with ww3 multi_1) to at least 1 arc-min.
2. Wave guidance consistent with forecaster-developed wind fields.
3. Improved economy of scale of centralized computing compared to distributed computing.



Issues/Risks

Issues: Additional computing capacity required; Multiple implementations (each of approx. 20 WFOs).

Risks: Implementation and testing may take longer than usual; On-demand run capability is yet untested.

Mitigation: Funding secured for 4 additional nodes (through Feb 2017). Funding a dedicated SPA for 8 months to work with EMC: An initial testing period of Sept-Nov 2014 is added up-front to test on-demand run capability. Actual implementation and testing occurs during Mar-Jul 2015.



Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	06/01/15	
Code delivered to NCO	06/01/15	
Technical Information Notice Issued	07/01/15	
CCB approve parallel data feed	07/01/15	
Parallel & IT testing begun in NCO	07/01/15	
Real-Time Evaluation & IT testing Ends	08/01/15	
Management Briefing	08/15/15	
Implementation (2 pilot offices, MFL & BOX)	09/01/15	
Implementation (remaining 20 offices in SR&ER)	09/30/15	

Implementation shifted by 2 quarters to allow for additional development and testing. Sandy implementation milestone (FY15Q4) unaffected.



Finances

Associated Costs:

- 1) \$250,000 - Applied to IBM Task Order 4 to augment WCOSS by 4 nodes (approx 1%). *However, a **continuous (24 h) reservation of 6 nodes** is required for this on-demand system.*
- 2) \$147,180 - To hire dedicated SPA for extended testing and implementation period (Sept-Nov 2014, Mar-Jul 2015)

Funding Sources: Sandy Supplemental; OST development funding.



Management Attention Required



Potential Management Attention Needed



On Track



WCOSS development & testing schedule

	Mar				Apr				May				June				July				Aug				Sept						
	Week				Week				Week				Week																		
Action	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Automate P-Surge extraction script																															
End-to-end testing; Include run triggering																															
Implement P-Surge extraction script																															
Test restart (hotstart) capability																															
Integrate error checks (for critical parts of code)																															
Psuedo operational testing of final code																															
Code freeze, NCO implementation commences																															
Parallel & IT testing begun in NCO (MFL & BOX)																															
NCEP Management Briefing																															
Implementation MFL & BOX																															
Implmentation all ER and SR WFOs																															
Actions at regional level																															
Develop domains for ILM, PHI, OKX																															
Upgrade all local installs to latest NWPS																															
All ER WFOs evaluate BOX-WCOSS results																															
BOX runs on WCOSS, remaining WFOs stand by																															

AWIPS 14.4.1
release